MANUFACTURES.

No. I.

ADDITION TO THE JACQUARD LOOM.

The Sum of FIVE POUNDS *was presented to Mr. W.* ROOKE, 30 *Union Street, Hope Town, Bethnal Green, for his Addition to the Jacquard Loom; a Model of which has been placed in the Society's Repository.*

EVERY one knows that in the common loom for plain weaving, the threads of the *warp*, that is, the longitudinal ones, are arranged alternately into two equal sets; that by the raising of one set an angle is formed between the two, and that the *shoot*, or cross-thread, is introduced into this angle by a throw of the shuttle; that the set of warp-threads which was first raised is then depressed, and the other set raised, forming a fresh angle, into which the shoot is introduced by a second throw of the shuttle. Thus, by raising each set of warp-threads alternately, and throwing the shuttle from right to left, and returning it from left to right, a web is produced of perfectly similar texture in every part. But if a number greater or less than half of the warp-threads be raised at once, it is evident that this will produce a variation in the appearance of

that part of the web. Such a variation regularly repeated is a pattern or figure; and all patterns or figures dependent on the weaving are produced in this way.

In the loom for figured silks every thread of the warp is passed through an eye in a vertical cord, to the bottom of which a leaden weight is attached, in order to keep it straight, and to bring the warp-thread down again by overcoming the friction; and, therefore, by raising any one of these vertical cords, the warp-thread belonging to it is also raised. By tying together the cords of all those warp-threads that require to be raised at the same time, a single movement will lift the whole of them, and form an angle, or *shed*, into which the shoot is to be laid by a throw of the shuttle, as already described. For complicated patterns, the number of *ties* or groups into which the warp-threads are arranged is so great, that much difficulty was experienced in attaching them to any kind of apparatus capable of being worked by treadles actuated by the feet of the weaver.

M. Jacquard, a weaver of Lyons, invented a highly ingenious machine for this purpose, which, from the inventor, goes by the name of the Jacquard loom. He attached a wire, hooked at the end, to every set or group of cords, and arranged them vertically over a triangular bar, capable of being raised by the action of a treadle, and called the *lifting bar*, because, when in the act of being raised, it carries up with it all those cords or ties the hooks of which catch on the bar. But this, in the natural position of the hooked wires, would be the case with all of them; it, therefore, became necessary to devise some means of temporarily pushing back the hooks of all those cords that were not to be raised, in order that the others, being lifted, should form the shed of the warp. This is effected

in the following manner: Each of the hooked wires passes through an eye in the middle of a straight piece of wire, and all these latter wires are arranged horizontally on a frame with the ends projecting a little beyond one side of the frame; the other end abuts against a spring, which yields to any gentle pressure made on the projecting end, and returns it to its place again when that pressure is removed. It is evident, therefore, that if simultaneous pressure is made on the ends of some of the horizontal wires, they will recede, and carry back with them the hooked wires that pass through their eyes, so as to prevent these latter from catching on the lifting-bar when raised by the treadle.

In front of the projecting ends of the horizontal wires is hung a four-sided wooden prism, having as many holes bored in each side as there are projecting wires: this prism has a swinging motion, and turns a quarter round at each oscillation. Now, if this were the whole of the apparatus, it is plain that the prism could produce no effect on the horizontal wires, for the ends of them would be received at each swing of the prism into the corresponding holes of the prism, and thus all pressure on their ends would be avoided. But if we cover each face of the prism, as it swings successively against the horizontal wires, with a piece of pasteboard, called a *pattern-card*, pierced with holes, corresponding to those of the prism, opposite to some only of the horizontal wires, it is evident that these will remain in their places, and all the other horizontal wires will be pushed back, thus withdrawing the hooked wires with which they are connected from the action of the lifting-bar, which, when raised, will carry up with it only those cords the hooks of which have not been pushed back; or, in other words, those the horizontal

wires of which were opposite to the holes in the pattern-card. A throw of the shuttle is made after every oscillation of the prism: as many pattern-cards, therefore, are required as there are throws of the shuttle from the beginning to the repetition of the pattern, including the plain part which lies between such repetition and also between the different portions of the pattern itself. In patterns of no uncommon extent, the number of cards required is 1700 or 1800, nearly half of which are repetitions of a very few being wanted for the plain work alone.

In Vol. XL. of the Society's Transactions is a description of the old loom, with an improved draw-boy by which the figure or pattern was determined. In Vol. XLVII. will be found Mr. Hughes's improvement on the Jacquard loom, by which one set of cards is made to hold two patterns; and in Vol. XLVIII. is Mr. Jennings's improvement of the Jacquard machine, and also a simplified machine by Mr. Dean.

Mr. Rooke's improvement relieves the band from all the repeating cards which form the ground, and causes their work to be done from a second treadle; thus easing the weaver by the more equal use of his legs on two treadles, and saving a considerable expense and bulk of cards.

For this purpose Mr. Rooke constructs a very small Jacquard machine, and places it at the back of the larger one, and at *right angles* to it, and this is worked by a treadle at the other foot. With this small machine he uses a little band, containing no more cards than there are variations in those repetitions of which the great band of cards is thus relieved.

Fig. 1, Plate II. is a view of the small machine taken from the back of the loom; consequently, if the whole loom

was shewn, the larger machine (like fig. 2 or 10, Plate VI. Vol. XLVIII.) would be seen behind this.

a a is the compass-board, *b b* the usual lifting cords from the large machine *x x*. Mr. Rooke's additional lifting or binding-cords, proceed in twenty-four pairs from the large machine to the twenty-four shafts *d d*, and *c c* are the lifting-cords from his small machine which proceed in eight pairs to the same twenty-four shafts: these being sixteen in number, form eight pairs; each pair is divided into three; these three join three of the cords *x x x*, and go to the ends of three shafts *d d*, as shewn in fig. 8: so three are lifted together by the small machine, there being twenty-four shafts and only eight changes: these threes are used for a satin ground: when other grounds are to be formed, the shafts are arranged so that two or only one may be lifted by each pair of cords from the small machine, the small band in that case containing a suitable increase of cards: the holes in these cards are always in pairs, in order the better to lift the shafts at each end. *e* is the revolving bar, *f* the band of eight cards upon it, corresponding with the eight pairs of lifting cords: they are kept conveniently extended by a light rod *g g*, so as to revolve very correctly with the bar *e*.

Fig. 2 is a larger view of the small machine, and fig. 3 a side view. *h* is the lever by which it is moved: if this were long enough to pass the large machine, the treadle would not give it sufficient motion; therefore it is met by another lever *i*, which receives motion from the treadle behind the weaver. The lever *h* turns the pulley *j*; this by a cord *k* raises up the lifting-frame *l*, shewn only by dotted lines in fig. 3. When this has taken up the proper hooks, the string *m* becomes tight enough to pull in the top of the batten *n*; this protrudes the batten-frame *o o*, which hangs

on centres *p p*, and also causes the bar *e* to revolve by the hook *q* retaining one corner of the bar whilst the rest is being carried out, and thus causes a quarter turn: a spring attached to the frame *o* pulls it back again quite close as soon as the treadle is suffered to rise, and presses the next card against the needles, the blanks pushing in those needles whose hooks are not to be raised. These machines are made with single, double, or quadruple rows of lifting hooks according to their work. Fig. 1 has but sixteen hooks, and all in one row; fig. 2 has twenty-six in a row; and fig. 3 shews four such rows, forming what is called a short one hundred machine.

In the machines formerly described, each of the four sides of the revolving bars was bored with as many holes as there were needles, and in as many rows as there were rows of hooks. Mr. Rooke, instead of forming each row of distinct holes, cuts a continued groove in the prism, of the same depth as the holes, whereby he obtains increased facility in adjusting the pattern-card to the ends of the needles, and spares the care that otherwise would be required to keep the holes strictly equidistant.

In fig. 1, the bar *e* has but one groove on each side; in fig. 2, two grooves are shewn; whilst to make it suit fig. 3, four such grooves would be required. The lifting-frame *l l* slides as usual in grooves within the outer frame; in fig. 3, the bars are seen by dotted lines just under the hooks they have to lift. In fig. 4, four hooks are shewn, and only two of the needles; *r r* are the springs that protrude the ends of the needles towards the bar *e:* fig. 5 is a top view of one needle, *s* is the bend against which the spring *r* acts; a small wire passes through the bend *t*, which prevents the needles from ever being pushed too far by the springs *r*, and confines them to the bar *u*. *v v*,

figs. 1, 2, and 3, are screws to adjust the revolving bar *e* correctly to the needles; nuts *g g* are also placed on them, through which the rod *g* passes to extend the band of cards; these enable the rod to be adjusted to the exact height. The end adjustment of the revolving bar *e* is given by the screw-centres *p p*. The lower hook *w* is merely to cause a return of the band of cards, and thus undo the work, should any accident require it. To effect this, a string from the tail of hook *q* lifts it out of contact with the revolving bar, and at the same time brings the hook *w* in contact with it by means of the wire *q w*, which connects the two hooks: this causes the bar to revolve in the contrary direction, merely by the same action of the treadle as would be required for going on with the work, and thus, by reversing the motion of the cards, enables the workman to unravel till he arrives at the part where any error has been committed.

This monture, as before stated, contains twenty-four shafts *d d*, connected in threes to the small machine by eight pairs of binding or lifting-cords *c c*. These twenty-four shafts have all the warp attached to them, and are also all connected to the larger machine, not in sets, but singly by twenty-four pairs of binding-cords *x x x*: thus either machine will lift the shafts, so that there are three ways by which the warp can be raised; first, by the shafts and small machine, in eight portions; secondly, by the shafts and large machine, in twenty-four portions; and lastly, by the large machine, in the usual variable portions, without the shafts.

The holes in the cards, and the hooks by which the large machine lifts the shafts, are purposely placed outside the other sets, the better to distribute them in pairs, and also to keep the weight equal on the lifting-frame *l*.

Fig. 6 is a side view with respect to the loom, and an end view of the compass-board: it shews the twenty-four pairs of lifting-cords *x x* divided, one half to the right and the other to the left, so as to be lifted by hooks at each end of the frame *b*. *c c* are the lifting-cords from the small machine: here one half is hid behind the other, the hidden part proceeding to the other end of the compass-board (as shewn in fig. 1); the dots at the lower *c* shew where they divide into three—of course the higher they are divided the less will be the divergence of the cords—they then are joined to the cords *x x*, just above the compass-board *a*, as seen in fig. 8. *d d* shews the ends of the twenty-four shafts, and *y y* the warp. *b* shews the usual lifting-cords from the Jacquard machine placed between the additional ones. Fig. 7 shews two lifting-cords *x* and *c*, proceeding from the two machines towards the compass-board, just above which they join, and then pass through to the end of a shaft *d*. *b b b* shew three of the usual lifting-strings, one up, the others down; they have loops *b b* through which the shaft passes, so that they can go up singly like the one shewn raised, but when either machine lifts a shaft it takes all up together.

In this machine, when a figure of one colour is worked on a ground of one other colour, the two treadles are alternately used; if the figure has two colours, the treadle of the large machine will be used twice to the other one; if four colours, then they will be used as four to one. When any colour goes off the pattern, a bell rings; and when all the colours are off, the small machine only is used to work the ground. In fig. 1, *y y* shews the place of the warp; *z z* are the weights.